

Coastal Benthic Optical Properties (CoBOP) of Coral Reef Environments: Effects of Changes in the Spectral Quality and Quantity of the Underwater Light Field on Productivity and Fluorescence Yields of Hermatypic Corals

Dr. Michael P. Lesser

University of New Hampshire

Department of Zoology and Center for Marine Biology

Durham, NH 03824

phone: (603) 862-3442 fax: (603) 862-3784 e-mail: mpl@christa.unh.edu

Award #N00149510593

LONG-TERM GOAL

My principal goal is to understand the mechanistic basis for changes in the fluorescent signatures, both host and algal symbiont, of corals. Changes in the spectral quantity and quality of visible and ultraviolet radiation will have effects on the quantum yield of photosynthesis and affect the fluorescent signatures of the algal symbionts as will changes in the temperature of the surrounding seawater. Since the reef environment is very dynamic, the challenge is to understand what environmental factors are responsible for the greatest variability in these fluorescent optical signatures at small to large scales and understand sufficiently to model them over space and time.

OBJECTIVES

The Coastal Benthic Optical Properties (CoBOP) project is directed at understanding the optical properties of coastal benthic communities in general, and in particular, coral reefs. Coral reef communities are coastal areas of high water transparency which make them ideal systems to study optical signatures originating from the benthos. The scientific objectives of my project are: to understand the relationship between primary productivity and chlorophyll fluorescence in hermatypic corals and identify the temporal and spatial scales of variability in this optical signature.

APPROACH

Studies were conducted in August 1995 on Long Key Reef at 10 m depth in the Dry Tortugas, Florida and 18 m off of Loggerhead Key, Dry Tortugas in June 1996. During

Report Documentation Page			Form Approved OMB No. 0704-0188		
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 30 SEP 1997		2. REPORT TYPE		3. DATES COVERED 00-00-1997 to 00-00-1997	
4. TITLE AND SUBTITLE Coastal Benthic Optical Properties (CoBOP) of Coral Reef Environments: Effects of Changes in the Spectral Quality and Quantity of the Underwater Light Field on Productivity and Fluorescence Yields of Hermatypic Corals			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University of New Hampshire, Department of Zoology and Center for Marine Biology, Durham, NH, 03824			8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 4	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

The shape of the modeled P - I relationship for *Montastraea faveolata* and *Montastrea cavernosa* from 18 m are very similar to 10 m productivity results with the expected decline in maximum productivity with increasing depth. For both depths the P - I curve for *M. faveolata* shows that the available irradiance is insufficient to saturate photosynthesis but does saturate photosynthesis for *M. cavernosa*.

The spectral absorption coefficient, normalized to chlorophyll, for both *M. faveolata* and *M. cavernosa* has the typical peaks associated with chlorophyll absorption. Additionally, samples of *M. cavernosa* exhibit lower spectrally corrected absorption coefficients. The fluorescence data at 685 nm shows an inverse relationship between productivity and fluorescence suggesting that the fluorescence yields are affected by the physiological status of these corals. Additionally, for both 10 and 18 m, the minimum quantum requirements are higher for *M. faveolata* compared to *M. cavernosa*. Both species of coral have high concentration of UV absorbing compounds at 18 m although only half as much as conspecifics at 10 m depth.

IMPACT/APPLICATIONS

The major implication for this work is that chlorophyll fluorescence yields appear to be directly related to the photosynthetic state of these benthic organisms, and their depth of occurrence. Additionally, for corals at the same depth the fluorescence yields are very different. These differences in fluorescence yields suggest fundamental, potentially genetic, differences in the phenotypic features of the symbiotic dinoflagellates, or zooxanthellae of corals. The differences for these conspecifics will need to be taken into consideration, as well as differences between much more divergent species, when developing models to understand the variability in optical signatures.

TRANSITIONS

The data collected from the 1996 and 1997 field seasons is presently being prepared for publication. In that process other members of the CoBOP team will be able to utilize a complete data set on two species of coral at two depths to look at factors influencing the optical properties of those corals.

RELATED PROJECTS

Charlie Mazel-ONR, CoBOP

Charlie Yentsch-ONR, CoBOP

Dave Phinney-ONR, CoBOP

Paul Falkowski-ONR, CoBOP

REFERENCES

M. P. Lesser, C. Mazel, C. Yentsch, and D. Phinney. Benthic Optical Properties of Coral Reefs: Effects of Changes In The Spectral Quality and Quantity of the Underwater Light Field on Productivity and Fluorescence Yields of Hermatypic Corals.
(Manuscript in preparation for Limnology and Ocenaography)

<http://nightsea.mit.edu/research/cobop/lsl/lsl.html>